Apr 16th, 11:00 AM - 2:00 PM

Using Osteohistology to Determine the Taxonomic Validity of the Late Cretaceous Dinosaur Nanotyrannus lancensis Bakker et al., 1988 (Theropoda: Tyrannosauridae)

Chris Griffin
Cedarville University, chrisgriffin@cedarville.edu

Using osteohistology to determine the taxonomic validity of the Late Cretaceous dinosaur *Nanotyrannus lancensis* Bakker et al., 1988 (Theropoda: Tyrannosauridae)

Chris Griffin
School of Arts and Sciences
Cedarville University

Abstract

Nanotyrannus lancensis is a putative Tyrannosaurid species from the Late Cretaceous (Maastrichtian) of North America, distinguished from the coeval *Tyrannosaurus rex* by body size, number of teeth and some minor cranial characters. However, many workers have not accepted *N. lancensis* as a valid taxon, instead proposing that specimens identified as *N. lancensis* represent juvenile *T. rex*. In this study, I examined the osteohistology of a tibia, a pubis, and three ribs of a single *N. lancensis* individual recovered from the Lance Formation of eastern Wyoming in order to determine the degree of skeletal maturity of the individual. All elements sectioned have a cortex primarily comprised of zonal fibrolamellar bone tissue with primarily longitudinal vascularization, with cancellous bone comprising the interior of the element. Bone tissue becomes less vascularized in zones closest to the sub-periosteal region, but this region still remains vascularized. Innermost portions of the cortex display Haversian remodeling in all thin sections. Lines of arrested growth (LAGs) and associated annuli are present in all elements sectioned: 6-8 in a rib (HRS08507); 1 in the tibia (HRS08421); 11-13 in the pubis (HRS01514). Extensive Haversian remodeling, resulting in dense Haversian tissue, is especially prevalent in the pubis and ribs (HRS08514, HRS08467), which presumably resulted in earlier LAGs being destroyed during ontogeny. No medullary cavity migration appears to have occurred, though medullary expansion probably destroyed the earliest LAGs. Some elements possess double and triple LAGs, which were considered one growth cessation event. All growth zones decrease in size outwardly. No external fundamental system (EFS) was observed in any element sectioned.

I conclude that the individual studied was at minimum 12-13 years old when it died, although earlier LAGs were probably destroyed by remodeling and medullary expansion. The individual had not ceased growth as evidenced by the vascularized sub-periosteal layer; however, the longitudinal vascularization and decrease in vascularization in sub-periosteal zones indicate that the individual's growth was slowing, as well as a shift from woven to parallel-fibered bone matrix in outer growth zones. This, in addition to extensive haversian remodeling, indicates that the individual was not a juvenile. I conclude that *Nanotyrannus lancensis* Bakker et al., 1988 is a distinct taxon from *Tyrannosaurus rex* Osborn, 1905.

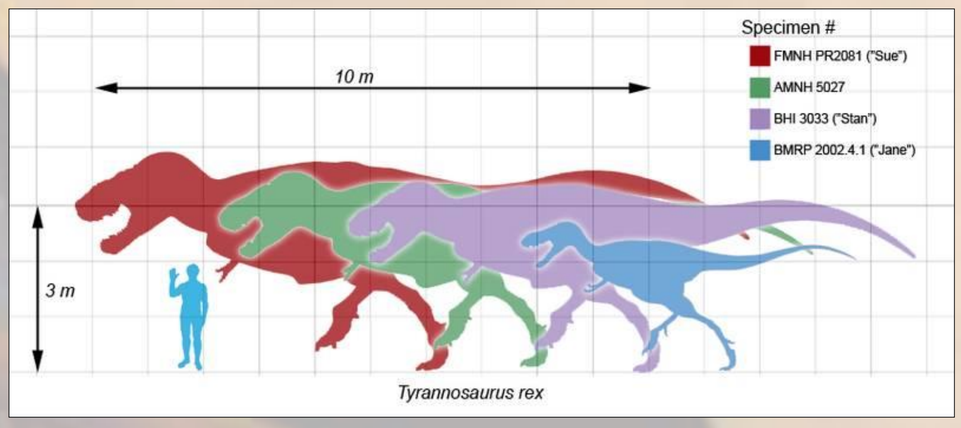

Figure 2. Size comparison of *T. rex* specimens, *N. lancensis* in blue.

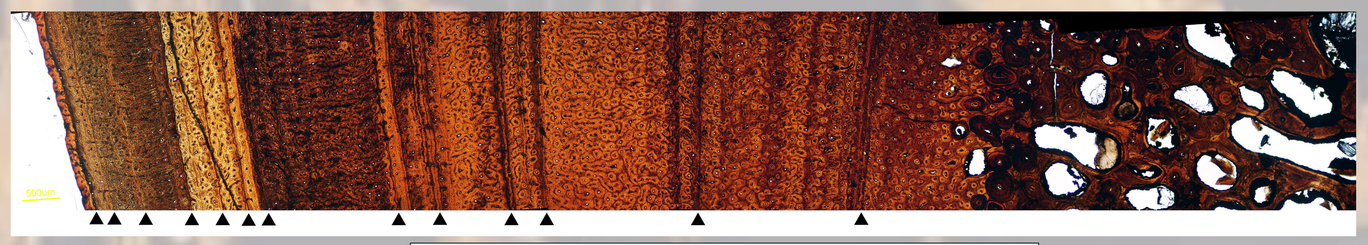

Figure 3. Primary bone of pubis (HRS081514), showing 13 growth lines and decrease in growth zone thickness.

Figure 4. Dense haversian tissue in A) *N. lancensis* pubis (HRS081514) and B) rib (HRS08467). Scale bar = 0.5 mm

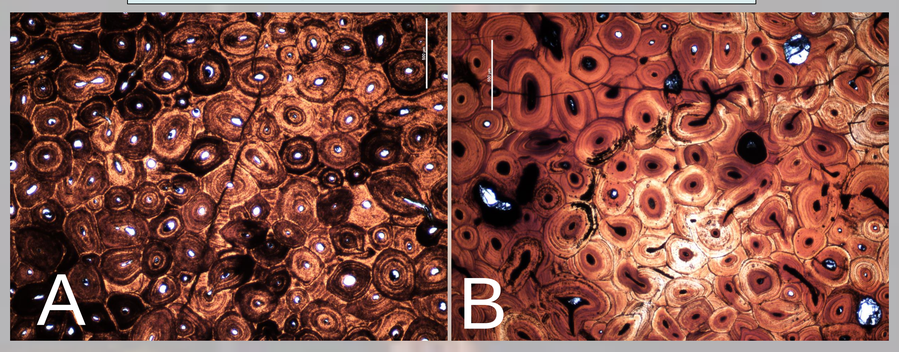

Figure 5. Cortical bone of rib (HRS08507) showing LAGs, change in vascular density, and change from woven to parallel-fibered bone. In plane- and cross- polarized light.

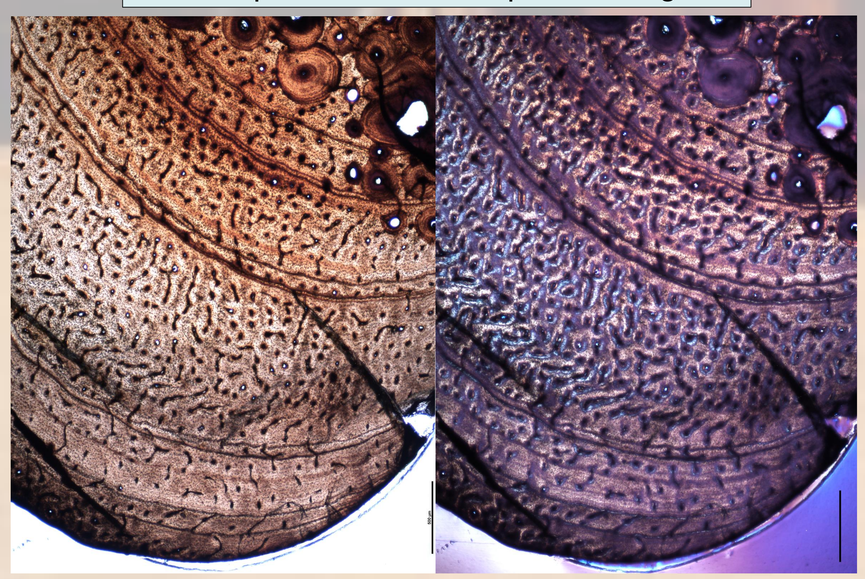

Figure 6. Thin section of pubis (HRS081514) showing primary zonal bone (ZB) and secondary remodeled bone (RB).

References

Bakker, R.T., Williams, M., and Currie, P., 1988, *Nanotyrannus*, a new genus of pygmy tyrannosaur, from the Latest Cretaceous of Montana: Hunteria, v. 1, p. 1-30.
Osborn, H. F. 1905. Tyrannosaurus and other Cretaceous carnivorous dinosaurs: Bulletin of the American Museum of Natural History, v. 21, p. 259–265.